By trying quick reversals and getting a few means, very accurate results can be obtained, only the resistance of the fault must not be very high.

Yours faithfully, ANDREW JAMIESON.

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To find the diameter λ of a wire to fill a bobbin of given dimensions (outer diameter A, inner diameter a, length b) and produce a given resistance R, allowance being made for the radial thickness ρ of the insulating covering :—

$$\text{Length of 1st coil} = 2\pi\left(\frac{a}{2} + \rho + \frac{\lambda}{2}\right),$$

$$\text{,, of 2nd ,,} = 2\pi\left(\frac{a}{2} + 3\rho + \frac{3\lambda}{2}\right),$$

$$\text{,, of two together} = 2\pi\left(2\frac{a}{2} + 4\rho + \frac{4\lambda}{2}\right),$$

$$\text{,, of } n \text{ coils} = 2\pi\left(n\frac{a}{2} + n^2\left(\rho + \frac{\lambda}{2}\right)\right),$$

$$= 2\pi n\left(\frac{a}{2} + n\left(\frac{2\rho + \lambda}{2}\right)\right),$$

$$\text{Number of coils} = \frac{\mathrm{A} - a}{2(2\rho + \lambda)} = n.$$

$$\text{Total length of 1 layer} = \frac{\pi(\mathrm{A} - a)}{2\rho + \lambda}\left[\frac{a}{2} + \frac{\mathrm{A} - a}{4}\right],$$

$$= \frac{\pi(\mathrm{A} - a)}{2\rho + \lambda}\left[\frac{\mathrm{A} + a}{4}\right].$$

$$\text{Number of layers} = \frac{b}{2\rho + \lambda},$$

Therefore total length is—

$$\mathrm{L} = \frac{\pi b(\mathrm{A} - a)(\mathrm{A} + a)}{4(2\rho + \lambda)^2},$$

Now

$$b\,\mathrm{R} = c\frac{\mathrm{L}}{\lambda^2}.$$

and

$$\mathrm{L} = \frac{\mathrm{R}\lambda^2}{c}.$$

therefore

$$\frac{R\lambda^2}{c} = \frac{\pi b(A-a)(A+a)}{4(2\rho+\lambda)^2},$$

therefore

$$(\lambda^2 + 2\rho\lambda)^2 = \frac{\pi b c(A-a)(A+a)}{4R},$$

therefore

$$\lambda^2 + 2\rho\lambda = \sqrt{\frac{\pi b c(A-a)(A+a)}{4R}},$$

adding ρ^2 to both sides

$$\lambda^2 + 2\rho\lambda + \rho^2 = \rho^2 + \sqrt{\frac{\pi b c(A^2-a^2)}{4R}},$$

From which

$$\lambda = -\rho + \sqrt{P\rho^2 + \sqrt{\frac{\pi bc(A^2-a^2)}{4R}}},$$

or if $k = c\frac{\pi}{4}$,

$$\lambda = -\rho + \sqrt{\rho^2 + \sqrt{\frac{kb(A^2-a^2)}{R}}},$$

when k is the resistance of a wire $\frac{\pi}{4}$ units in length and one unit in diameter.

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